

WHAT IS CLAIMED IS:

- 1 1. A device for analyzing microparticles, comprising:
 - 2 a chamber comprising an inlet and an outlet for respectively introducing and
 - 3 dispensing a flowing fluid comprising microparticles;
 - 4 a light source adapted to provide incident light through the chamber;
 - 5 a photometer configured to measure the intensity of light transmitted through
 - 6 individual microparticles; and
 - 7 an imaging system configured to acquire images of the flowing fluid within the
 - 8 chamber.
- 1 2. The device of claim 1, further comprising additional light sources configured to
- 2 provide incident light through the chamber at different wavelengths than the light source.
- 1 3. The device of claim 1, wherein the chamber is configured to induce a laminar
- 2 flow of the fluid
- 1 4. The device of claim 1, wherein the chamber comprises a channel having a width
- 2 between approximately 10 microns and approximately 1200 microns.
- 1 5. The device of claim 1, further comprising a microprocessor controller with a
- 2 storage medium comprising program instructions for analyzing the measured light
- 3 intensities and acquiring images of the flowing fluid.

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1 6. The device of claim 5, wherein the storage medium further comprises program
2 instructions for controlling fluid flow through the chamber.

1 7. The device of claim 1, wherein the imaging system comprises a magnification
2 lens configured to enlarge the appearance of individual microparticles within the flowing
3 fluid to be equal to or slightly larger than a pixel size of the images produced by the
4 imaging system.

1 8. The device of claim 1, further comprising a moveable mirror system configured to
2 reflect the light transmitted through the chamber to the imaging system.

1 9. The device of claim 1, wherein the device is configured to operate from battery
2 power.

1 10. A microparticle flow sensor system, comprising:

2 a chamber comprising opposing optical view ports;

3 one or more light sources configured to provide incident light through the optical
4 view ports;

5 an imaging system configured to acquire images of a fluid flowing within the
6 chamber; and

7 a storage medium comprising program instructions executable using a processor
8 for:

9 identifying and characterizing microparticles within the fluid; and

10 determining a quantity of the microparticles.

1 11. The microparticle flow sensor system of claim 10, further comprising bandpass
2 filters configured to simultaneously collect light intensity data from multiple wavelengths
3 of the incident light.

1 12. The microparticle flow sensor system of claim 10, wherein the program
2 instructions for identifying the microparticles within the fluid comprise program
3 instructions for distinguishing different types of microcapsules contained within the fluid.

1 13. The microparticle flow sensor system of claim 12, wherein the program
2 instructions for identifying the microparticles within the fluid comprise program
3 instructions for distinguishing the microcapsules from debris microparticles.

1 14. The microparticle flow sensor system of claim 10, wherein the program
2 instructions for identifying the microparticles within the fluid comprise program
3 instructions for determining a shape and size of the microparticles.

1 15. The microparticle flow sensor system of claim 10, wherein the program
2 instructions for identifying the microparticles within the fluid comprise program
3 instructions for tracking the trajectory of particles within a fluid.

1 16. The microparticle flow sensor system of claim 10, wherein the program
2 instructions for identifying the microparticles within the fluid comprise program
3 instructions for comparing measured intensities of light transmitted through the
4 microparticles at different locations within the chamber.

1 17. The microparticle flow sensor system of claim 10, wherein the program
2 instructions for identifying the microparticles within the fluid comprise program

3 instructions for matching the measured light intensities with spectral characteristics of
4 known microparticles.

1 18. A method for identifying and tracking microparticles in motion, comprising:

2 flowing a fluid comprising microparticles in laminar motion through a chamber;

3 transmitting light through the fluid within the chamber;

4 measuring the intensities of the light transmitted through the fluid;

5 imaging the fluid a plurality of times as the microparticles flow through the
6 chamber; and

7 comparing at least some of the intensities of light between different images of the
8 fluid to detect and characterize the microparticles.

1 19. The method of claim 18, wherein the step of transmitting light comprises
2 transmitting a spectrum of light through the fluid.

1 20. The method of claim 18, wherein the step of flowing the fluid comprises flowing
2 the fluid at a rate between approximately 0.10 milliliters per minute and approximately
3 1.0 milliliters per minute.

1 21. The method of claim 18, wherein the step of comparing the intensities of light is
2 used to identify and count the microparticles within the fluid.

1 22. The method of claim 18, further comprising comparing the different images of the
2 fluid to:

3 calculate a time of flight of individual microparticles; and

4 determine trajectories for the individual microparticles.

1 23. The method of claim 18, further comprising calculating sedimentation rates for
2 the particles within the fluid.

1 24. The method of claim 18, further comprising calculating buoyancy rates for the
2 particles within the fluid.

1 25. A device for analyzing microparticles, comprising:

2 a laminar-flow chamber comprising an inlet and an outlet for respectively
3 introducing and dispensing a flowing fluid comprising microparticles;

4 one or more light sources adapted to provide incident light through the chamber;

5 a photometer configured to measure the intensity of light transmitted through the
6 chamber;

7 an imaging system configured to acquire images of the flowing fluid within the
8 chamber; and

9 a storage medium comprising program instructions executable using a processor
10 for:

11 analyzing the measured light intensities;

12 acquiring images of the flowing fluid; and
13 identifying and characterizing the microparticles based upon the measured
14 light intensities and acquired images.

1 26. The device of claim 25, wherein the one or more light sources are adapted to
2 provide light of different wavelengths.

1 27. The device of claim 25, further comprising:

2 a moveable mirror system configured to reflect the light transmitted through the
3 chamber to the imaging system; and

4 a plurality of bandpass filters interposed between the moveable mirror system and
5 the imaging system, wherein the bandpass filters are configured to
6 simultaneously collect light intensity data from multiple wavelengths of
7 the incident light.

1 28. The device of claim 25, further comprising a fluid subsystem configured to clean
2 out the laminar-flow chamber.